

# Estimating bycatch and risk from fisheries & other human impacts

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# Key components of assessing impacts of bycatch

- Good estimates of mortality (incl. serious injury)
- Biological reference point (limit) against which to evaluate total human-caused mortality (bycatch + other removals)

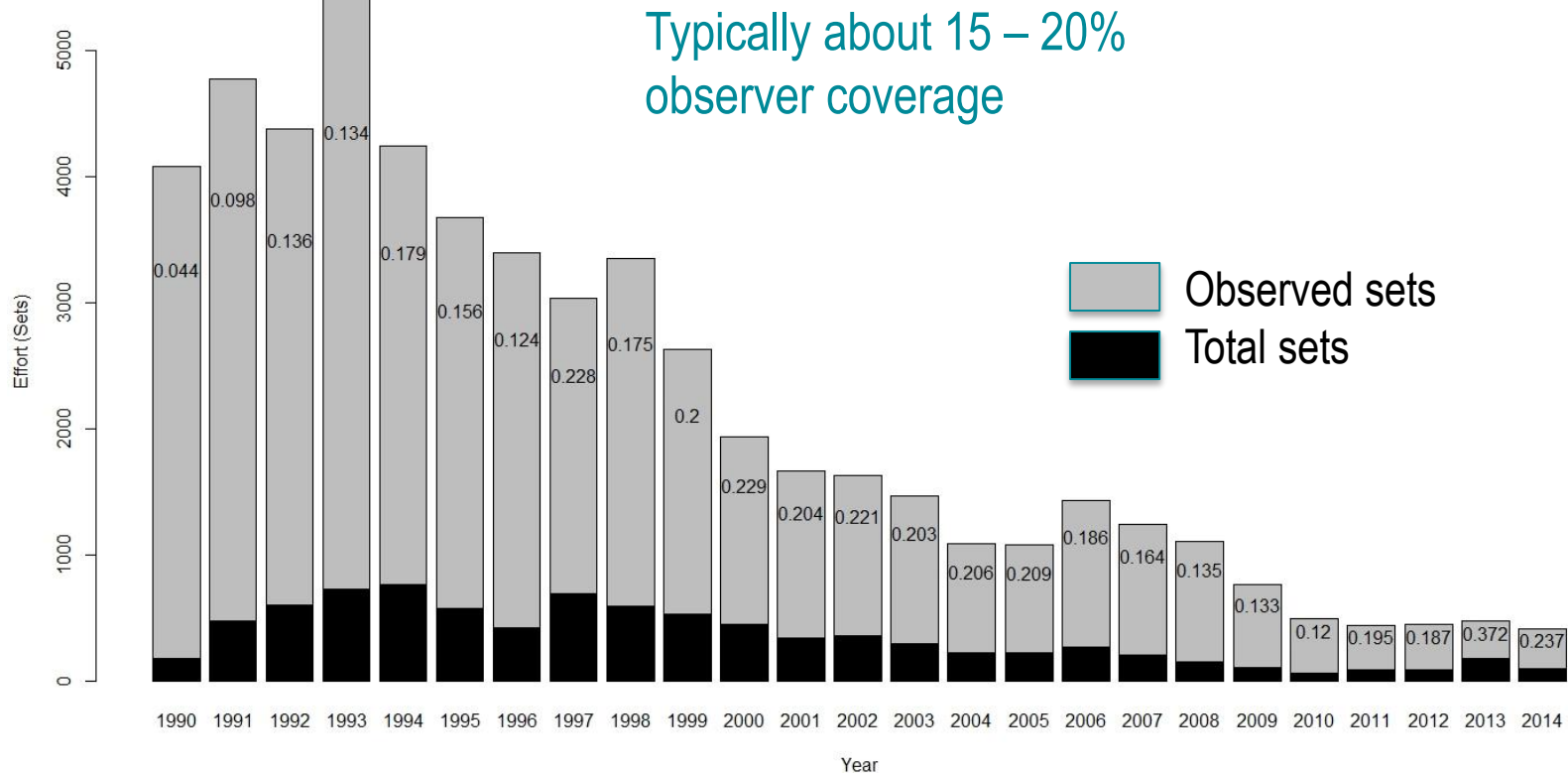
For marine mammal stock assessments, the mortality limit is PBR (Potential Biological Removal), developed at SWFSC

These parameters are informative for assessments and management decisions for other taxa as well

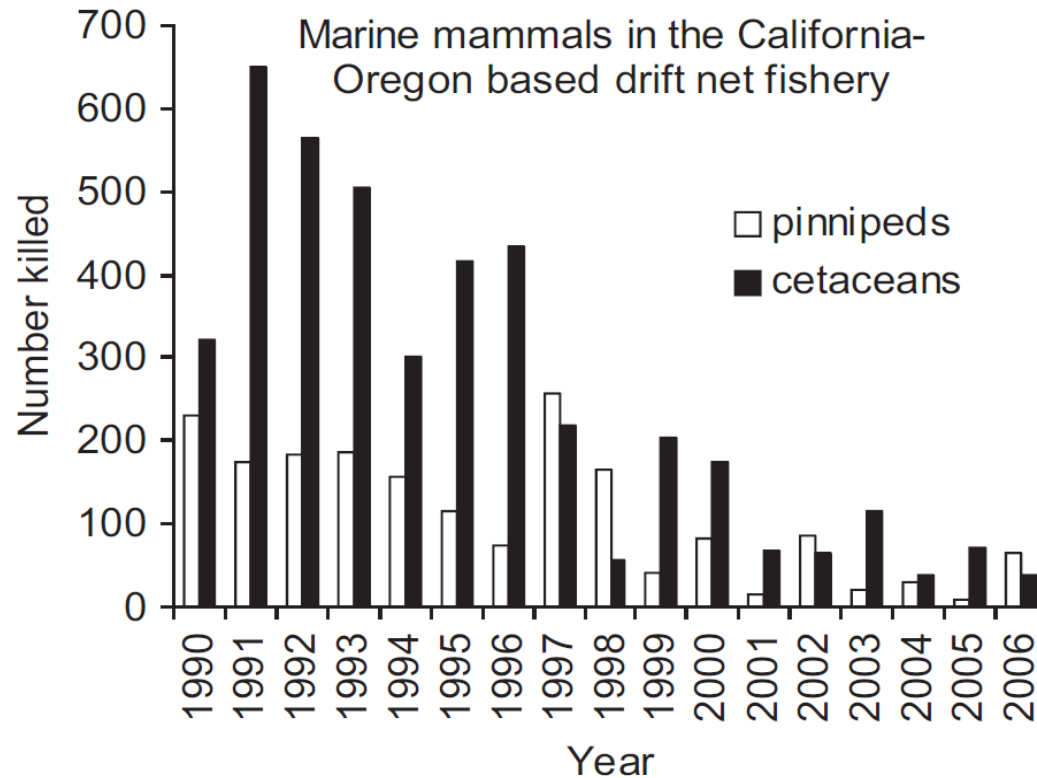
# Estimating bycatch

- DATA are from West Coast Region (WCR) scientific observer program (Lyle Enriquez et al.)
- Observed fisheries
  - **California large-mesh drift gillnet fishery (CDGN)** (targets: swordfish, thresher shark)
  - CA small-mesh drift net fishery (targets: yellowtail, barracuda, white sea bass)
  - Set gillnet fishery (targets: halibut & white sea bass)
  - Purse seine for small pelagics
  - At-sea hake (NWFSC)
  - CA-based longline (defunct)

# Observer effort in the CDGN fishery



# Marine mammal bycatch in the CDGN fishery

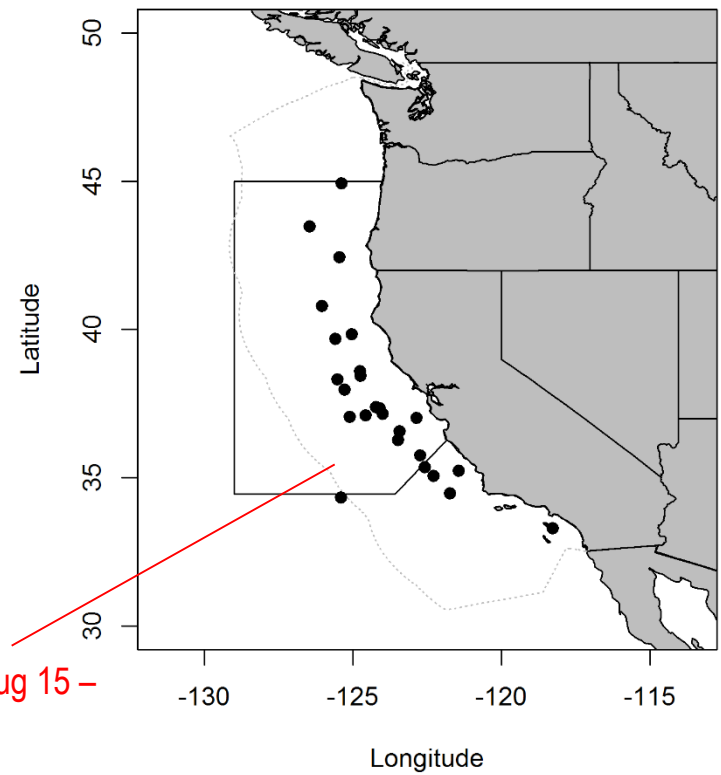


From Moore et al. 2009, Marine Policy 33: 435-451

# U.S. West Coast Bycatch Reduction Successes

- Pacific Offshore Cetacean Take Reduction Team
- Measures since ~ 1998
  - Required pinger use
  - Net-depth extenders
  - Skipper workshops
- Pacific leatherback conservation area (since 2001)

DGN Leatherback Bycatch Events



PLCA closed Aug 15 –  
Nov 15

# U.S. West Coast Bycatch Reduction Successes

MARINE MAMMAL SCIENCE, 24(4): 956–961 (October 2008)

No claim to original US government works

DOI: 10.1111/j.1748-7692.2008.00218.x

## Acoustic pingers eliminate beaked whale bycatch in a gill net fishery

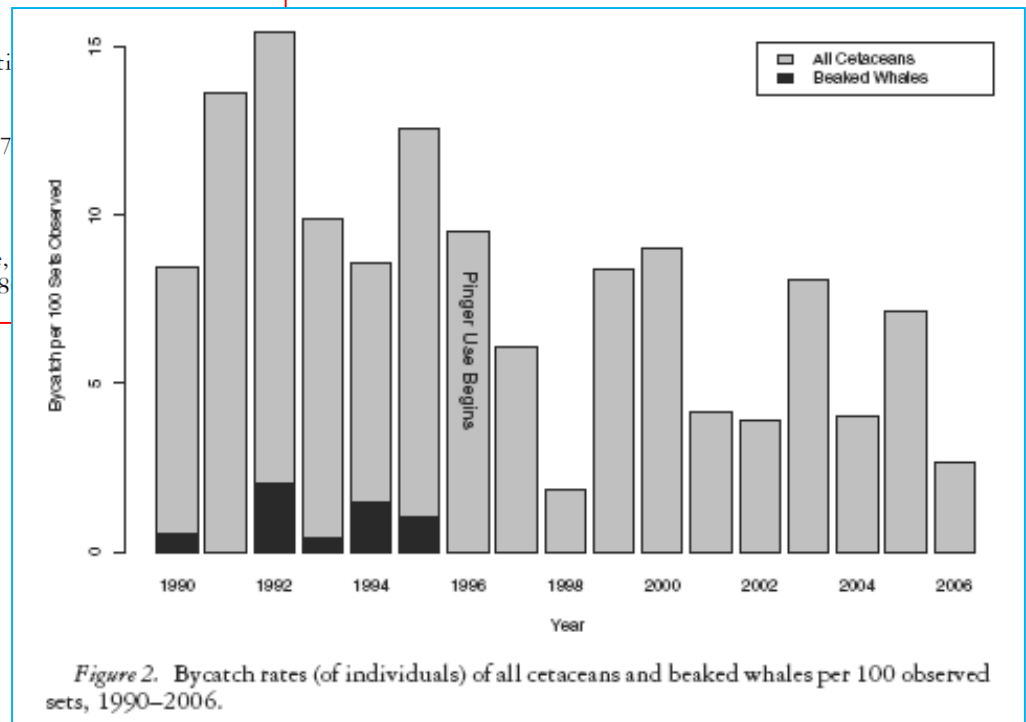
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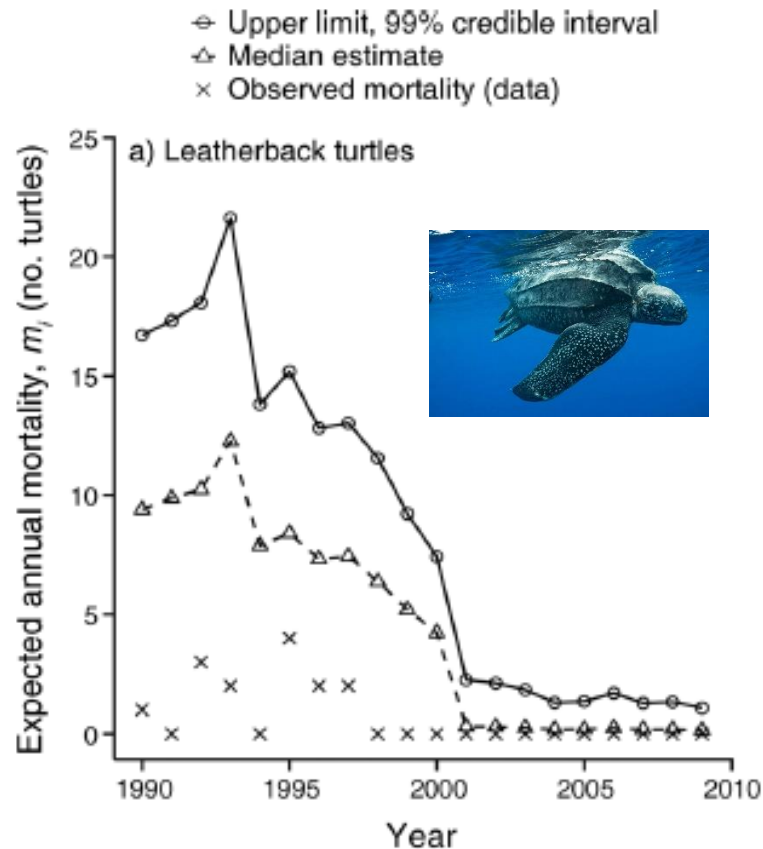
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# U.S. West Coast Bycatch Reduction Successes



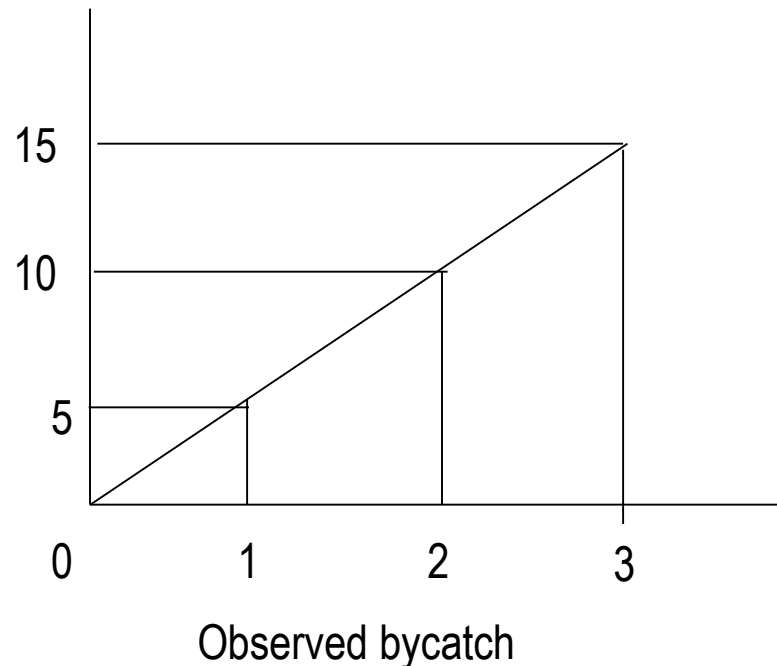
Martin et al. 2015



# Remaining bycatch challenges: Problem of rare-event bycatch

Bycatch estimates (and therefore management decisions) highly error-prone when observer coverage is fairly low, catch is rare, and the limit (e.g., PBR) is small

Estimate, with 20%  
observer coverage



# Remaining bycatch challenges: Problem of rare-event bycatch

## Sperm whale example

	<u>Observed bycatch</u>
1992	3
1993	3
1996	1
1998	1
2010	2



Ratio estimate for 2010 (12% obs covg): 16.7

5-year mean: 3.3 per yr

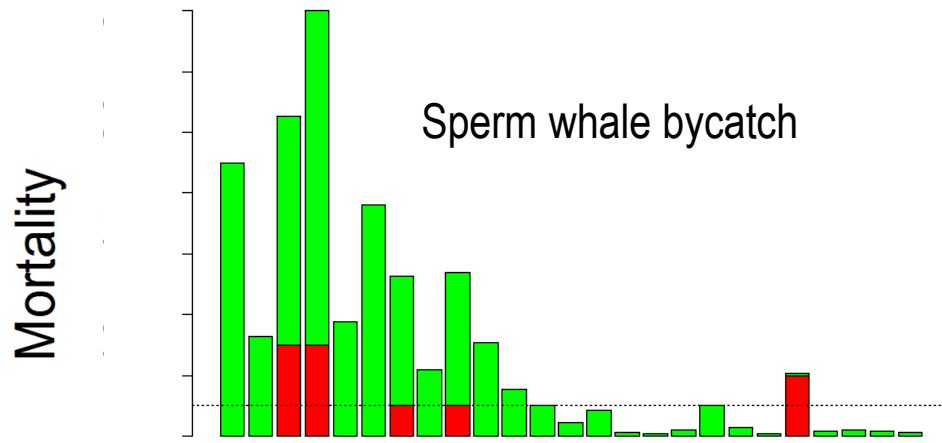
Potential Biological Removal: 1.5

Bycatch > PBR  Reinitiate TRT process

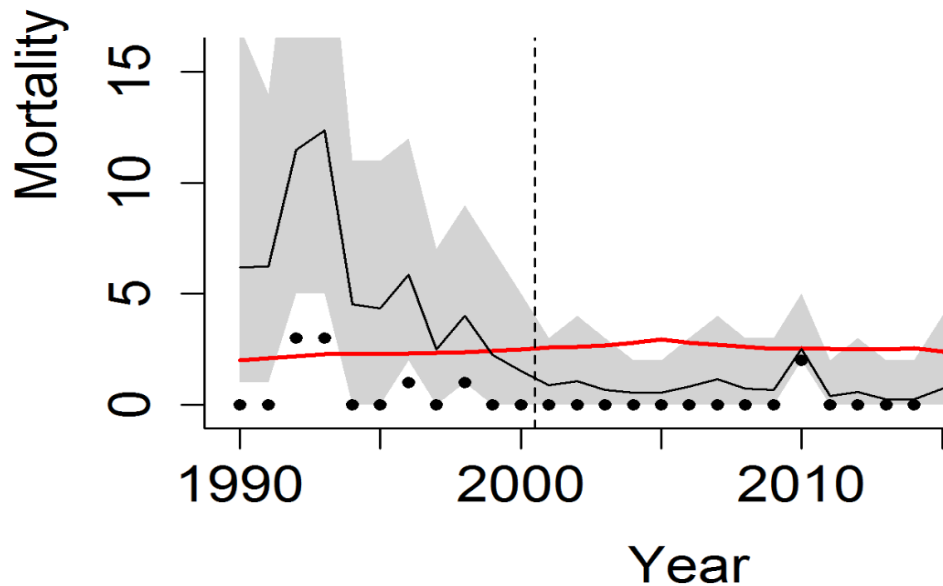


w/ Jim Carretta

# Toward model-based bycatch estimation



- Regression-TREE based approach



- Bayesian approach

# But how much human-caused mortality is too much?

- NOAA uses PBR (Potential Biological Removal) as a limit reference point for marine mammals
  - Also applicable to other taxa if mortality is non-selective
- RVLL (reproductive value loss limit), Curtis & Moore 2013
  - An alternative limit estimator for species with strongly age-structured reproductive value and age-selective impacts
  - Developed for sea turtles



w/ Alex Curtis

# Ingredients of limit-based management

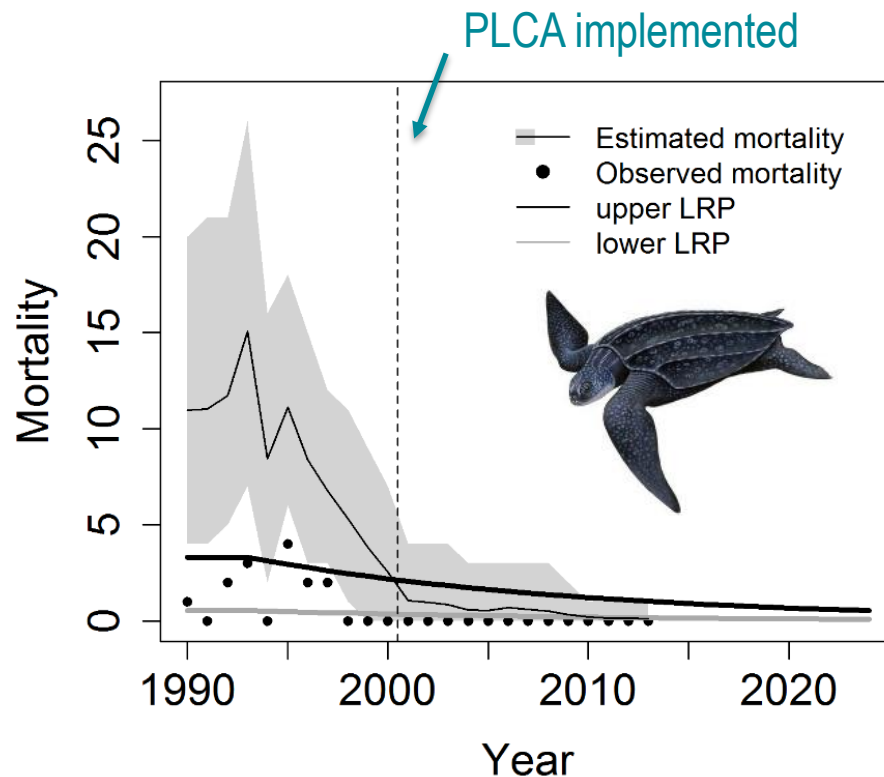
- Defining population units and conservation objectives
  - Ex: maintain population above MNPL
- Defining acceptable risk thresholds
  - Ex: Achieve conservation objective with 95% success rate
- Tuning a limit estimator to achieve desired performance in simulation testing
- Estimate input parameters (population productivity and abundance)

(Moore et al. 2013, Curtis et al. in press *Marine Policy*)

# Local limit reference point concept

- Limit is based on the abundance of animals potentially interacting with human activities in a managed area (e.g., US West Coast EEZ)
- Supports consistent management among regions of the same population
- Represents a local share of responsibility toward achieving conservation objectives for a shared resource
- Can be used to support incremental progress toward management objectives of transboundary populations

# Application to western Pacific leatherbacks in the west coast EEZ



Curtis, Moore & Benson.,  
in review

Funding support from  
NOAA S&T

# Potential value of LRPs for U.S. regulatory process

- Could be used to inform ESA assessments (e.g., jeopardy analyses, status reviews)
- Can help support consistent management across regions of same population, and across different species
- Provides justifiable limit alternatives for states, Fishery Mgmt Councils, etc. (as well as international sectors)
- Supports ecosystem-based fisheries management



# Future work

- Evaluating different models for improving bycatch estimation
- Developing user-friendly tools to facilitate broader application of bycatch estimation models
- Improving the RVLL (limit reference point) estimator to better account for uncertainty in reproductive value estimates

Support for several of these efforts comes from NOAA Science & Technology's **Protected Species Toolbox** initiative